

# **Biological Assessment Report**

## **Unnamed Tributary of Hickory Creek Study Grundy, Missouri**

**Fall 2008 - Spring 2009**

Prepared for:

Missouri Department of Natural Resources  
Division of Environmental Quality  
Water Protection Program  
Water Pollution Control Branch

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## **1.0 Introduction**

At the request of the Missouri Department of Natural Resources (**MDNR**), Water Protection Program (**WPP**), the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate bioassessment and habitat study of the unnamed tributary of Hickory Creek, water body identification number 589, in Grundy County in northeast Missouri. In addition, similarly sized streams were sampled to function as regional control streams. It was determined this approach may be beneficial given the size differences between the study stream and the bioreference streams already established for the Central Plains/Grand/Chariton Ecological Drainage Unit (**EDU**). An EDU is an ecological area in which the aquatic biological communities and stream habitat can be expected to be similar. See the inset in Figure 1 for general stream location of the unnamed tributary of Hickory Creek and the control streams within the Central Plains/Grand/Chariton EDU.

Five similarly sized streams were chosen as regional control streams. However, through the course of the study, the tributary of Cypress Creek, located in southern Harrison County became unacceptable as a control stream. During reconnaissance, the stream appeared suitable. By the fall 2008 sampling season the landowner had moved cattle into the field surrounding the sample reach, giving the cattle direct access to the stream. Between this time and spring 2009, the landowner had significantly altered the landscape and the stream itself. We determined the tributary was inconsistent with the desired reference conditions and it was not included as one of the regional control streams for this study.

The unnamed tributary of Hickory Creek is a tributary of Hickory Creek located approximately 7 miles southwest of Trenton in Grundy County. The unnamed tributary of Hickory Creek is classified as a Class "C" stream per the Missouri Water Quality Standards (MDNR 2005a). The U. S. Environmental Protection Agency (**EPA**) added a one mile section of this creek to the 303(d) list in 2002 for unknown pollutants. The unnamed tributary of Hickory Creek was sampled during fall 2006 and spring 2007 by MDNR's WQMS. The macroinvertebrate community of the unnamed tributary of Hickory Creek was determined to be impaired and additional sampling was recommended. The goal of this study is to provide additional data for the unnamed tributary of Hickory Creek and to reevaluate the stream for impairment.

This study assessed approximately one mile of the unnamed tributary of Hickory Creek from sec. 15, T. 60 N., R. 25 W. at the confluence with Hickory Creek upstream to sec. 9, T. 60 N., R. 25 W. in Grundy County (Missouri Water Quality Standards (**WQS**) (MDNR 2009a). According to the WQS, the unnamed tributary of Hickory Creek is a Class "C" (intermittent with perennial pools) stream, with the following designated uses: livestock and wildlife watering, protection of warm water aquatic life and human health fish consumption, and category B whole body contact recreation.

### **1.1 Purpose**

The purpose of the study was to assess the habitat characteristics, macroinvertebrate community, and physicochemical characteristics of the unnamed tributary of Hickory Creek to determine if the biological community was impaired.

### **1.2 Tasks**

- 1) Conduct a habitat assessment of the unnamed tributary of Hickory Creek and the four control streams.
- 2) Conduct a bioassessment of the macroinvertebrate community of the unnamed tributary of Hickory Creek and the four control streams.
- 3) Conduct physicochemical monitoring of the unnamed tributary of Hickory Creek and the four control streams.

### **1.3 Null Hypotheses**

- 1) Habitat will not differ substantially between longitudinally separate reaches of the unnamed tributary of Hickory Creek.
- 2) Habitat will not differ between the unnamed tributary of Hickory Creek and the four control streams selected in the Central Plains/Grand/Chariton EDU.
- 3) Macroinvertebrate assemblages will not differ substantially between longitudinally separate reaches of the unnamed tributary of Hickory Creek.
- 4) Macroinvertebrate assemblages will not differ substantially between the unnamed tributary of Hickory Creek and the four control streams selected in the Central Plains/Grand/Chariton EDU.
- 5) Macroinvertebrate assemblages will not differ substantially between the unnamed tributary of Hickory Creek and the bioreference streams in the Central Plains/Grand/Chariton EDU.

## **2.0 Methods**

Brandy Berghold and Carl Wakefield of the MDNR, Division of Environmental Quality, ESP, WQMS conducted this study. Sampling was conducted during the fall of 2008 and the spring of 2009. Fall sampling was conducted on September 23-25 2008 and consisted of macroinvertebrate sampling, habitat assessments, and water quality sampling at two stations on the unnamed tributary of Hickory Creek and at the control streams. During the spring, water quality and macroinvertebrate sampling were conducted on April 7-8, 2009. Methods are included for biological assessments, stream habitat assessments, and physicochemical water quality collection. Quality control was conducted according to MDNR Standard Operating Procedures and Project Procedures.

### **2.1 Station Descriptions**

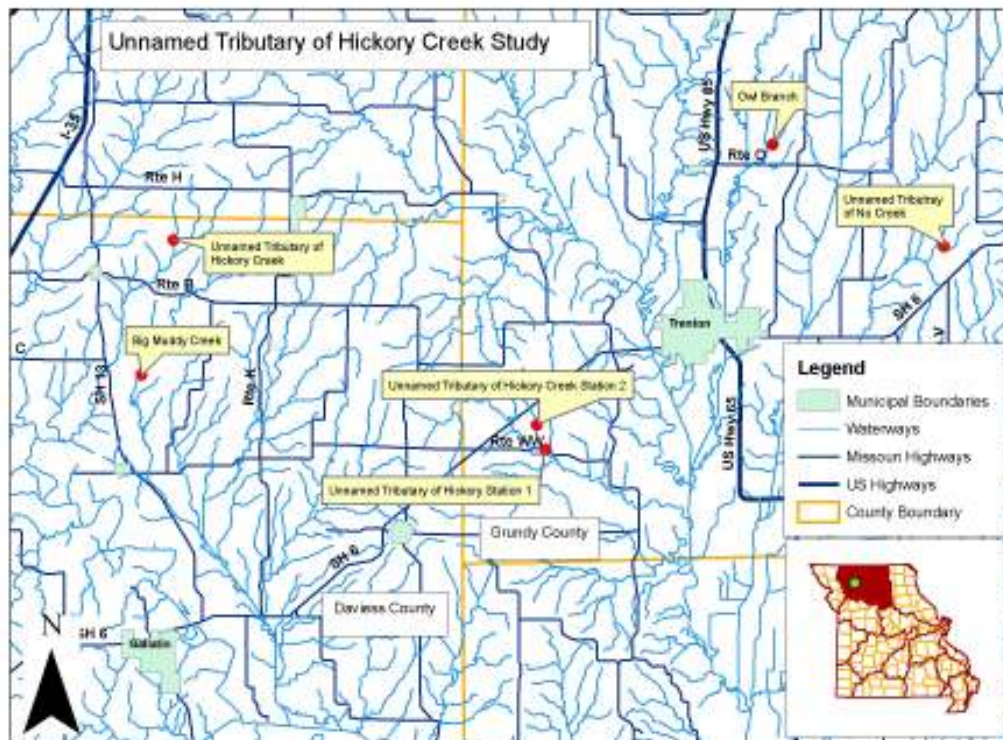
The study included sampling two stations on the unnamed tributary of Hickory Creek in Grundy County and four similarly sized control streams located in Daviess and Grundy Counties (Figure 1). Station locations and descriptions are listed below in Table 1.

Biological Assessment and Habitat Study  
 Unnamed Tributary of Hickory Creek, Grundy County  
 Fall 2008-Spring 2009  
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Table 1  
Descriptive Information for Stations in the Unnamed Tributary of Hickory Creek Study

Stations	Location - UTM Zone 15	Description	County
Unnamed Trib of Hickory Creek #1	439516 E 4430045 N	Downstream State Hwy WW	Grundy
Unnamed Trib of Hickory Creek #2	439516 E 4430045 N	Upstream of State Hwy WW.	Grundy
Control Streams			
Tributary of Hickory Creek	418569 E 4441455 N	Upstream of Beacon Road	Daviess
Owl Branch	452494 E 4447240 N	Downstream of NE 20 <sup>th</sup> Avenue	Grundy
Tributary of No Creek	462258 E 4441227 N	Downstream of 80 <sup>th</sup> Avenue	Grundy
Big Muddy Creek	416659 E 4434008 N	Upstream of Forest Avenue	Daviess

Figure 1  
Sampling Locations of the Unnamed Tributary of Hickory Creek and Regional Control  
Streams, Fall 2008 and Spring 2009



### 2.1.1 Land Use Description

The land use conditions were summarized from land cover GIS files. Percent land cover data were derived from Thematic Mapper (TM) satellite data collected between 2000 and 2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**). See Table 2 for a comparison of land use for the EDU and the 14-digit hydrologic unit codes (**HUC**) that contain the unnamed tributary of Hickory Creek Study segments.

Table 2  
 Percent Land Cover in the Unnamed Tributary of Hickory Creek  
 Study Stations and Central Plains/Grand/Chariton EDU

Stations	14-digit HUC	Urban	Crops	Grass	Forest
Unnamed Trib of Hickory Creek #1	10280102190005	4	36	34	19
Unnamed Trib of Hickory Creek #2	10280102190005	4	36	34	19
Control Streams					
Tributary of Hickory Creek	10280101160002	2	35	40	17
Owl Branch	10280102170003	8	32	43	11
Tributary of No Creek	10280102180002	1	15	66	11
Big Muddy Creek	10280101180001	2	44	38	12
Central Plains/Grand/Chariton EDU	————	2	28	45	18

## 2.2 Stream Habitat Assessment Project Procedure

Standardized assessment procedures were followed as described for glide/pool prevalent streams in the Stream Habitat Assessment Project Procedure (**SHAPP**) (MDNR 2003a). According to the SHAPP, the aquatic community is influenced by the quality of the stream habitat. Stream habitat quality is scored for each station and the scores are compared with the SHAPPs conducted at the control stations. If the SHAPP score at a test station is  $\geq 75\%$  of the SHAPP control scores, the stream habitat at the test station is considered to be comparable to the control streams. Four similarly sized streams located within the same EDU were chosen for comparison as the SHAPP control.

## 2.3 Bioassessment

### 2.3.1 Macroinvertebrate Sampling and Analyses

Macroinvertebrate sampling was conducted according to the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**) (MDNR 2003b). The unnamed tributary of Hickory Creek is considered a glide/pool dominated system. The three standard habitats of glide/pool streams sampled at all locations were: non-flowing water over depositional substrate (**NF**), large woody debris substrate (**SG**), and rootmat (**RM**). Macroinvertebrate samples were sub sampled in the laboratory and

identified to specific taxonomic levels (MNDR 2005a) in order to develop biological criteria metrics (MDNR 2003b).

Macroinvertebrate data were analyzed using three methods. The first analysis was to calculate the Macroinvertebrate Stream Condition Index (**MSCI**) using the biological criteria for perennial/wadeable streams from the Central Plains/Grand/Chariton EDU using the four general biological metrics found in the SMSBPP (MDNR 2001; MDNR 2002). Biological criteria are calculated separately for the fall (mid-September through mid-October) and spring (mid-March through mid-April) index periods. The Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure provides details on the calculation of metrics and scoring of the multi-metric MSCI. The four metrics of the MSCI are: Taxa Richness (**TR**); Ephemeroptera, Plecoptera, and Trichoptera Taxa (**EPTT**); Biotic Index (**BI**); and the Shannon Diversity Index (**SDI**). An MSCI score of 16-20 is considered as full biological sustainability, 10-14 as partial biological sustainability, and 4-8 as non-biological sustainability.

The second analysis was calculating MSCI scores using the macroinvertebrate data collected from the four similarly sized control streams chosen in the Central Plains/Grand/Chariton EDU using the four general biological metrics found in the SMSBPP. This analysis was done to determine whether stream size was important in assessing the impairment of the unnamed tributary of Hickory Creek using the macroinvertebrate community since the sampling stations were much smaller than the perennial/wadeable biological criteria reference streams used to calculate biological criteria for the Central Plains/Grand/Chariton EDU.

The third analysis was an evaluation of macroinvertebrate community composition by percent composition of EPT, Ephemeroptera, Plecoptera, Trichoptera, and the most abundant macroinvertebrate families. Comparisons of the macroinvertebrate community of the unnamed tributary of Hickory Creek sampling stations and the similarly sized control streams were made.

### **2.3.2 Physicochemical Water Sampling and Analyses**

Physicochemical water samples were handled according to the appropriate MDNR, ESP Standard Operating Procedure (**SOP**) and/or Project Procedure (**PP**). Results for physicochemical water parameters were examined by season and station. All physicochemical water parameters were sampled by field measurements or grab samples. Water samples were collected according to the SOP MDNR-ESP-001 Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2008a). All samples were kept on ice during transport to ESP.

Water quality parameters were measured *in-situ* or collected and returned for analyses at the state environmental laboratory. Temperature (C°) (MDNR2003c), pH (MDNR 2001a), specific conductance (μS) (MDNR 2003d), dissolved oxygen (mg/L) (MDNR



2002a), and discharge (cubic feet per second-cfs) (MDNR 2003e) were measured in the field. Turbidity (NTU) (MDNR 2005b) was measured and recorded in the ESP, WQMS biology laboratory. The ESP, Chemical Analysis Section (CAS) in Jefferson City, Missouri conducted the analyses for ammonia-nitrogen (mg/L), nitrate+nitrite-nitrogen (mg/L), total nitrogen (mg/L), chloride (mg/L), non-filterable residue (mg/L), and total phosphorus (mg/L).

Physicochemical water parameters were compared between stations as well as with Missouri's WQS (MDNR 2009a). Interpretation of acceptable limits in the WQS may be dependent on a stream's classification and its beneficial use as designated in the WQS (MDNR 2009a).

### **2.3.3 Discharge**

Stream flow was measured using a Marsh-McBirney Model 2000 Flo-Mate current meter at each station during the fall sampling season. Stream flow was measured using a SonTek/YSI FlowTracker® flow meter at each station during the spring sampling season. Velocity and depth measurements were recorded at each station according to SOP MDNR-WQMS-113 Flow Measurement in Open Channels (MDNR 2003e).

## **3.0 Results and Analyses**

### **3.1 Land Use**

The land use data in Table 2 provides a comparison between the 14-digit hydrologic units covered within the study reach of the unnamed tributary of Hickory Creek and the four similarly sized control streams with the Central Plains/Grand/Chariton EDU.

The land use coverage is fairly comparable between all of the study stations. The HUC containing Owl Branch has more urban coverage than the remaining sites. The city of Trenton is located downstream of Owl Branch within this HUC. There are slight variations of cropland versus grassland coverage at a few of the sites, specifically at the Tributary of No Creek which has the least amount of cropland and the most grassland. However, general land use is not expected to negatively impact the biological community.

### **3.2 Stream Habitat Assessment**

Scoring results of the habitat assessment are found in Table 3. According to SHAPP guidance, study stations scoring at least 75 percent of the total score of reference/control stations should support a similar biological community. The SHAPP scores for the control streams ranged from 94-113. The unnamed tributary of Hickory Creek #1 scored 108 and the unnamed tributary of Hickory Creek #2 scored 101. The average score for the four control streams is 102.75. The study stations scored >75 % of the average of the control streams and of the scores individually.

Table 3  
 Stream Habitat Assessment Scores and Percentage Comparison

Stations	SHAPP Scores	Percent of Control Stream Average
Unnamed Trib of Hickory Creek #1	108	>100
Unnamed Trib of Hickory Creek #2	101	98
Control Streams		
Tributary of Hickory Creek	94	Control Stream Average = 102.75
Owl Branch	95	
Tributary of No Creek	113	
Big Muddy Creek	109	

### 3.3 Biological Assessment and Macroinvertebrate Community Analyses

Tables 4-7 provide scoring criteria and results for the fall and spring index periods. Tables 4 and 6 show the results of all streams compared with the bioreference streams for the Central Plains/Grand/Chariton EDU for the fall 2008 sampling season and the spring 2009 sampling season, respectively. Tables 5 and 7 show the results of comparing the study stream, unnamed tributary of Hickory Creek, with the four similarly sized streams located with the same EDU for the fall 2008 and spring 2009 sampling seasons, respectively. MSCI scores were calculated by scoring station metrics against the appropriate Biological Criteria (BIOREF or control stream) scores located in the tables. An MSCI score of 16-20 results in an assignment of a fully supported biological community.

The two stations of the unnamed tributary of Hickory Creek scored an MSCI of fully supporting during both the fall and spring sampling seasons using both the bioreference criteria and control stream criteria. Slight differences in the scoring occurred when comparing the unnamed tributary of Hickory Creek data with the control streams versus the bioreference streams. However, the change in score did not alter the fully supporting category obtained by the stream during either sampling season.

Table 4  
 Bioreference (BIOREF) Criteria Metric Scores, Biological Support Category, and  
 Macroinvertebrate Stream Condition Index (MSCI) Scores, Fall 2008

Stations	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Unnamed tributary of Hickory Creek #1	0804078	70	10	7.3	3.43	18	Full
Unnamed tributary of Hickory Creek #2	0804079	71	10	7.1	3.13	20	Full
Control Streams							
Tributary of Hickory Creek	0804077	67	4	7.2	3.12	14	Partial
Owl Branch	0804080	65	6	7.4	3.35	16	Full
Tributary of No Creek	0804081	62	2	7.9	2.65	12	Partial
Big Muddy Creek	0804082	66	8	7.3	3.37	16	Full
BIOREF Score=5		>53	>9	<7.2	>2.69	20-16	Full
BIOREF Score=3		53-27	9-5	7.2-8.6	2.69-1.35	14-10	Partial
BIOREF Score=1		<27	<5	>8.6	<1.35	8-4	Non

MSCI Scoring Table (in light gray) developed from BIOREF streams (n = 18). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

Table 5  
 Control Criteria Metric Scores, Biological Support Category, and Macroinvertebrate  
 Stream Condition Index (MSCI) Scores, Highlighting Changes (**in Bold**) in Scores Using  
 Similar-Size Stream Criteria, Fall 2008

Stations	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Unnamed Trib of Hickory Creek #1	0804078	70	10	7.3	3.43	<b>20</b>	Full
Unnamed Trib of Hickory Creek #2	0804079	71	10	7.1	3.13	20	Full
Control Score=5		>64	>3	<7.5	>3.00	20-16	Full
Control Score=3		64-32	3-1	7.5-8.7	3.00-1.50	14-10	Partial
Control Score=1		<32	<1	>8.7	<1.50	8-4	Non

MSCI Scoring Table (in light gray) developed from control streams (n = 4). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

During the fall, the unnamed tributary of Hickory Creek station #1 MSCI score increased from 18 to 20 when compared to the control streams. In reviewing the scoring criteria, this data revealed the similarly sized control streams to have a higher TR, BI, and SDI than the bioreference streams.

Table 6  
 Bioreference (BIOREF) Criteria Metric Scores, Biological Support Category, and  
 Macroinvertebrate Stream Condition Index (MSCI) Scores, Spring 2009

Stations	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Unnamed Trib of Hickory Creek #1	0930031	63	6	7.3	3.32	16	Full
Unnamed Trib of Hickory Creek #2	0930032	53	8	7.2	2.89	20	Full
Control Streams							
Tributary of Hickory Creek	0930035	33	1	8.4	1.93	10	Partial
Owl Branch	0930034	45	4	7.7	2.62	14	Partial
Tributary of No Creek	0930033	55	5	8.2	2.28	14	Partial
Big Muddy Creek	0930036	57	8	7.6	2.69	16	Full
BIOREF Score=5		>51	>8	<7.3	>2.53	20-16	Full
BIOREF Score=3		51-25	8-4	7.3-8.7	2.53-1.27	14-10	Partial
BIOREF Score=1		<25	<4	>8.7	<1.27	8-4	Non

MSCI Scoring Table (in light gray) developed from BIOREF streams (n = 23). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

Table 7  
 Control Criteria Metric Scores, Biological Support Category, and Macroinvertebrate  
 Stream Condition Index (MSCI) Scores, Highlighting Changes (**in Bold**) in Scores Using  
 Similar-Size Stream Criteria, Spring 2009

Stations	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Unnamed Trib of Hickory Creek #1	0930031	63	6	7.3	3.32	<b>20</b>	Full
Unnamed Trib of Hickory Creek #2	0930032	53	8	7.2	2.89	20	Full
Control Score=5		>42	>3	<8.3	>2.19	20-16	Full
Control Score=3		42-21	3-1	8.3-9.1	2.19-1.09	14-10	Partial
Control Score=1		<21	<1	>9.1	<1.09	8-4	Non

MSCI Scoring Table (in light gray) developed from control streams (n = 4). TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

During the spring, the unnamed tributary of Hickory Creek station #1 MSCI score increased from 16 to 20 when compared to the control streams. In reviewing the scoring criteria, this data revealed the similarly sized control streams to have lower biological metric values except for biotic index when compared to the bioreference streams.

The fall 2008 community analysis is shown in Table 8. Of the EPT taxa, all stations had Ephemeroptera and lacked Plecoptera. The stations on the unnamed tributary of Hickory Creek had Trichoptera and three of the four control streams had Trichoptera. Chironomidae and Physidae were the dominant families at the Hickory Creek stations. Chironomidae was fairly abundant at all of the control stations. Tubificidae, Physidae, and Enchytraeidae were also common in the control streams. Hyallellidae was the dominant family at the Tributary of No Creek but fairly uncommon at the rest of the sites.

Table 8  
 Fall 2008 Macroinvertebrate Community Analysis

Station	Unnamed Trib of Hickory Creek #1	Unnamed Trib of Hickory Creek #2	Control Streams	Trib of Hickory Creek	Owl Branch	Trib of No Creek	Big Muddy Creek
% Ephemeroptera	3.9	7.5		1.7	3.7	8.1	6.8
% Plecoptera	0	0		0	0	0	0
% Trichoptera	2.4	3.4		0.3	1.4	0	5
Total EPT %	6.5	10.9		2.0	5.1	8.1	11.8
% Diptera	59.2	74.3		73.3	64.3	24.2	73.2
% Dominant Families							
Chironomidae	48.9	69.8		59.8	53.1	19	69.6
Physidae	8.2	4.9		4.1	1.9	7.2	1.5
Tubificidae	6.4	4.1		4.9	3.7	6.6	7.3
Dryopidae	6.1	1.5		5.1	10.9	0.4	0.3
Enchytraeidae	2.4	0.7		2.9	7.9	1.3	1.5
Caenidae	1.8	1.3		1.5	2.9	7.5	3
Hyalellidae	1.2	0		0	1.9	41.1	0.2

The spring 2009 macroinvertebrate community analysis is shown in Table 9. Trichoptera were present at all of the stations. Ephemeroptera were present at all stations except for the control site, the tributary of Hickory Creek. Plecoptera were present at both stations of the unnamed tributary of Hickory Creek and Owl Branch. Chironomidae was the dominant family at all the stations during the spring. Either Enchytraeidae or Tubificidae ranked as the second dominant family at station #1 and station #2 of the unnamed tributary of Hickory Creek, respectively, as well as at the control stations.

Table 9  
 Spring 2009 Macroinvertebrate Community Analysis

Station	Unnamed Trib of Hickory Creek #1	Unnamed Trib of Hickory Creek #2	Control Streams	Trib of Hickory Creek	Owl Branch	Trib of No Creek	Big Muddy Creek
% Ephemeroptera	2.7	3.9		0	0.6	4.2	3.5
% Plecoptera	2.7	1.8		0	0.4	0	0
% Trichoptera	2.4	2.7		1.3	5.2	1.9	0.3
Total EPT %	7.8	8.4		1.3	6.2	6.1	3.8
% Diptera	64.5	75.2		94.4	81.4	79.7	90.5
% Dominant Families							
Chironomidae	49.4	70.6		92	79.5	76.6	87.3
Enchytraeidae	13.4	3.3		2.6	6.9	1.4	1.4
Tubificidae	7.6	6.6		0	1.8	5.8	3.2
Tipulidae	5.3	1.3		0.2	1.2	0.2	0
Crangonyctidae	5	5.7		0.6	0	4.2	0

### 3.4 Physicochemical Water Parameters

Physicochemical results from both sampling seasons can be found in Tables 10 and 11. Physicochemical water quality results for the study stations were not elevated and most likely did not have an impact on the biological community during the study seasons.

Table 10  
 Fall 2008 Physicochemical Water Parameters

Stations							
Parameters	Unnamed tributary of Hickory Creek #1	Unnamed tributary of Hickory Creek #2	Control Streams	Trib of Hickory Creek	Owl Branch	Trib of No Creek	Big Muddy Creek
Ammonia as N (mg/L)	0.03*	0.03*		0.03*	0.03*	0.46	0.03*
Chloride (mg/L)	13.1	12.8		5.36	6.20	22.4	7.65
Dissolved Oxygen (mg/L)	6.47	6.13		6.23	6.67	6.38	7.17
Flow (cfs)	0.22	0.21		0.18	0.90	0.32	7.06
pH (su)	7.67	7.87		7.83	7.67	7.34	7.65
Specific Conductance (µS/cm)	552	566		284	312	309	344
Temperature (°C)	18.8	21.5		27.0	23.1	21.4	17.2
Turbidity (NTU)	4.17	3.95		3.40	34.7	25.5	31.7
Nitrate+Nitrite as N (mg/L)	0.01*	0.01		0.01*	0.30	0.25	0.22
Total Nitrogen (mg/L)	0.38	0.38		0.52	0.84	1.64	0.73
Total Phosphorus (mg/L)	0.23	0.16		0.17	0.11	0.78	0.14

\* Below detectable limits

During the fall sampling season, total nitrogen at the Tributary of No Creek was 1.64 mg/L. This value is elevated when compared to EPA's recommended reference value of 0.86 mg/L total nitrogen for the level III ecoregion (Central Irregular Plains) (U. S. EPA 2000). Missouri does not have nutrient criteria at this time but is currently in the process of developing nutrient criteria for rivers and streams based on a regional scale.

Table 11  
 Spring 2009 Physicochemical Water Parameters

Stations	Unnamed tributary of Hickory Creek #1	Unnamed tributary of Hickory Creek #2	Control Streams	Trib of Hickory Ck	Owl Branch	Trib of No Creek	Big Muddy Ck
Parameters							
Ammonia as N (mg/L)	0.03*	0.03*		0.03*	0.05	0.03*	0.03*
Chloride (mg/L)	10.4	10.4		11.9	5.14	5.94	8.29
Dissolved Oxygen (mg/L)	11.6	10.4		12.0	9.42	9.68	12.0
Flow (cfs)	0.9	0.90		0.54	1.49	0.68	6.16
pH (su)	8.20	8.30		8.40	8.0	7.90	8.3
Specific Conductance (µS/cm)	460	457		432	324	273	426
Temperature (°C)	7.90	10.8		4.90	11.6	13.2	9.80
Turbidity (NTU)	12.5	8.23		13.3	72.3	9.26	8.36
Nitrate+Nitrite as N (mg/L)	0.13	0.13		0.58	0.19	0.07	0.43
Non-Filterable Residue (mg/L)	19.0	12.0		16.0	52.0	5.00*	8.0
Total Nitrogen (mg/L)	0.42	0.47		0.97	0.58	0.37	0.73
Total Phosphorus (mg/L)	0.01*	0.01*	0.01*	0.05	0.01*	0.01*	

\* Below detectable limits

#### 4.0 Discussion

During 2008, Missouri experienced above normal precipitation. The northwestern part of the state experienced several major flood events during the summer months, setting record rainfall events during the month of July. Although the area had experienced above normal precipitation, the channel flow status ranked in the mid range for all the streams. The channel had areas exposed along the banks. The substrate consisted mostly of sand and was unconsolidated, making it difficult to walk through.

The SHAPP scores for the study streams scored >75% of the SHAPP scores (4 scores of the control streams averaged and of the individual scores) for the control streams. All of these streams were characteristic of having wide, shallow channels consisting mostly of loose sand. Many of the streams had expansive areas of what would be considered run habitat. In some cases, due to the extensive run habitat areas, it was difficult to find enough non-flowing habitats and a few streams lacked enough rootmat.



The study stream and the control streams all ranked low on the availability of epifaunal substrate. None of the streams appeared to suffer from any form of channelization. Both stations on the unnamed tributary of Hickory Creek ranked low on vegetative protection of the banks. Station #1 had substantial riparian cover on either side of the stream but the riparian cover at station #2 was sparse on both sides of the stream. This station had grassland on either side of the stream.

The macroinvertebrate data did not reveal any impairment in the unnamed tributary of Hickory Creek, WBID 589, during either sampling season. When compared to the control streams and the bioreference streams, the unnamed tributary of Hickory Creek scored in the fully supporting range. It was hypothesized that the unnamed tributary of Hickory Creek would have a macroinvertebrate community that was less diverse and balanced than the bioreference streams used to calculate biological criteria in the Central Plains/Grand/Chariton EDU and would instead need to be compared to the control criteria streams. But based on the results of this study, the unnamed tributary of Hickory Creek samples were comparable to the bioreference criteria and the control criteria was not needed to determine impairment.

There were slight variations in the community makeup during each sampling season for the unnamed tributary of Hickory Creek. Chironomidae was the dominant family at the unnamed tributary of Hickory Creek stations during the fall, with station #2 having a greater abundance than station #1. Physidae and Tubificidae ranked as the second and third dominant families at both stations. Chironomidae was also the dominant family during the spring sampling period, again, with station #2 having a greater abundance. At station #1, Enchytraeidae and Tubificidae were the second and third dominant families. At station #2, Tubificidae and Crangonyctidae were the second and third dominant families. Total EPT taxa ranged from 6.5% to 10.9% during the fall and 7.8% to 8.4% during the spring. Plecoptera were absent at both stations during the fall and found at both stations during the spring. As for the control streams, during the fall sampling, the dominant taxa at the tributary of Hickory Creek, Owl Branch, and Big Muddy consisted of Chironomidae and Amphipoda was the dominant taxa at No Creek. During the spring sampling, Chironomidae was the dominant taxa at the control streams. All streams exhibited taxa indicative of intermittent conditions.

The physicochemical data does not show any significant trends. During the fall, specific conductance was slightly higher at the unnamed tributary of Hickory Creek stations than the control streams. This is likely due to the rainfall received the night before sampling. During the spring sampling, turbidity was elevated at Owl Branch when compared with the other streams. However, it appears that physicochemical water quality did not affect the biological community during the study seasons.

MDNR's WQMS conducted a bioassessment on the unnamed tributary of Hickory Creek during fall 2006 and spring 2007 and determined the macroinvertebrate community to be impaired. Additional sampling was recommended for the study stream and for

intermittent control streams within the EDU to evaluate criteria for comparison to smaller streams. The WQMS noted low flow conditions and areas of the stream bed that were dry during the fall that prohibited sampling the macroinvertebrate community. In addition, road work had recently been completed along that section of the highway that disturbed the stream. The unnamed tributary of Hickory Creek was only sampled during the spring of 2007 due to the drought conditions. During this time, the Midwest was suffering from an extended period of drought conditions. Since that time, the Midwest has experienced several years of abundant rainfall which provided a chance for the macroinvertebrate community to recover from the drought conditions. This has led to MSCI scores to score in the fully supporting category.

## **5.0 Conclusion**

Five null hypotheses were stated in the introduction: 1) Habitat will not differ substantially between longitudinally separate reaches of the unnamed tributary of Hickory Creek; 2) Habitat will not differ between the unnamed tributary of Hickory Creek and the four control streams selected in the Central Plains/Grand/Chariton EDU; 3) Macroinvertebrate assemblages will not differ substantially between longitudinally separate reaches of the unnamed tributary of Hickory Creek; 4) Macroinvertebrate assemblages will not differ substantially between the unnamed tributary of Hickory Creek and the four control streams selected in the Central Plains/Grand/Chariton EDU; 5) Macroinvertebrate assemblages will not differ substantially between the unnamed tributary of Hickory Creek and the bioreference streams in the Central Plains/Grand/Chariton EDU.

Null hypothesis #1 was accepted. The SHAPP scores for the two unnamed tributaries of Hickory Creek stations differed by only 7 points. The habitat of the unnamed tributary of Hickory Creek stations was comparable.

Null hypothesis #2 was accepted. The unnamed tributary of Hickory Creek stations scored >75% of the SHAPP scores for the control streams. Land use and SHAPP scores revealed the habitat of the unnamed tributary of Hickory Creek stations was comparable to control streams within the Central Plains/Grand/Chariton EDU.

Null hypothesis #3 was accepted. The macroinvertebrate community of the unnamed tributary of Hickory Creek stations exhibited similar dominant taxa and had MSCI scores in the fully supporting category at both sampling stations during each sampling season.

Null hypothesis #4 is accepted. The macroinvertebrate community of the unnamed tributary of Hickory Creek stations ranked as fully supporting when compared to the control streams for both sampling seasons and therefore, did not substantially differ from the MSCI calculated from the control streams within the same EDU.

Null hypothesis #5 is accepted. Again, the macroinvertebrate community of the unnamed tributary of Hickory Creek stations ranked as fully supporting when compared to the

bioreference streams for both sampling seasons and therefore, did not substantially differ from the MSCI calculated from the bioreference streams within the same EDU.

Overall, the bioassessment for the unnamed tributary of Hickory Creek, WBID 589, suggests no biological impairment due to water quality or habitat parameters. The MSCI scores for both unnamed tributaries of Hickory Creek stations during both seasons were >16, indicating a healthy macroinvertebrate community when compared to the selected control streams and the bioreference streams for that EDU. The habitat scores for the study stations were considered comparable to the control stations. The physicochemical results revealed few definitive trends other than typical seasonal differences.

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## **Appendix A**

Invertebrate Database Bench Sheet Report  
Unnamed Tributary of Hickory Creek, Grundy County  
and  
Four Similarly Sized Control Streams, Daviess and Grundy Counties  
Grouped by Season and Station

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0804078], Station #1, Sample Date: 9/24/2008 9:45:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>AMPHIPODA</b>			
Crangonyx		6	
Hyaella azteca		6	
<b>COLEOPTERA</b>			
Agabus		3	
Helichus basalis	2	19	9
Laccobius	2		1
Laccophilus		2	
<b>DECAPODA</b>			
Orconectes immunis		6	
<b>DIPTERA</b>			
Ablabesmyia	3	5	2
Ceratopogoninae	7	4	1
Chironomidae		3	
Chironomus	1		
Chrysops	15	3	
Corynoneura		3	
Cricotopus bicinctus	2		
Cryptochironomus	2	2	
Dicrotendipes	1		2
Diptera	3		1
Dolichopodidae	1	1	
Forcipomyiinae	1		
Glyptotendipes		1	
Gonomyia	4		4
Hydrobaenus	1	2	
Labrundinia		1	
Mesosmittia		1	
Nanocladius		2	
Ormosia		1	
Paracladopelma	1		
Parametriocnemus		2	1
Paratanytarsus	2	9	1
Paratendipes	1	2	1
Phaenopsectra	1	2	2
Polypedilum convictum		1	
Polypedilum fallax grp			1
Polypedilum halterale grp	6		2
Polypedilum illinoense grp	2	13	3
Rheotanytarsus		1	1

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0804078], Station #1, Sample Date: 9/24/2008 9:45:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Saetheria	20	10	1
Simulium	1		
Stenochironomus			1
Tabanus	1		-99
Tanytarsus	49	17	7
Thienemanniella	1	2	
Thienemannimyia grp.	1	20	4
Tipula	1	1	
Zavrelimyia	2	13	
<b>EPHEMEROPTERA</b>			
Acerpenna	1	3	1
Baetis		1	
Caenis latipennis	3	6	
Centroptilum		1	
Ephemeridae	1		
Procloeon	1		
Stenonema femoratum	1		
<b>HEMIPTERA</b>			
Belostoma		-99	
Gerris	1		
Microvelia			1
Neoplea	1		
Sigara	12	2	1
Trepobates		2	
<b>LIMNOPHILA</b>			
Physella	5	33	2
<b>MEGALOPTERA</b>			
Chauliodes		1	
<b>ODONATA</b>			
Calopteryx		1	
Ischnura		1	
Libellula	1		
<b>TRICHOPTERA</b>			
Cheumatopsyche			1
Helicopsyche	1		
Ptilostomis	1	9	
<b>TRICLADIDA</b>			
Planariidae		3	
<b>TUBIFICIDA</b>			
Enchytraeidae	5	5	2



**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0804078], Station #1, Sample Date: 9/24/2008 9:45:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Limnodrilus hoffmeisteri	1		
Tubificidae	16	7	7

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0804079], Station #2, Sample Date: 9/24/2008 12:30:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina		2	
<b>AMPHIPODA</b>			
Crangonyx	2	7	
<b>COLEOPTERA</b>			
Dytiscidae	1	1	
Helichus basalis	2	4	6
Scirtidae		1	
Stenelmis		1	
<b>DECAPODA</b>			
Orconectes		1	
<b>DIPTERA</b>			
Ablabesmyia	15	1	3
Ceratopogoninae	8	1	2
Chironomidae	6	5	2
Chironomus	3	1	
Chrysops	4		
Cladotanytarsus	2		
Corynoneura	2	1	3
Cricotopus bicinctus	8	18	4
Cricotopus/Orthocladius	1	2	1
Cryptochironomus	2		
Dicrotendipes	2		6
Diplocladius		1	
Diptera	3	4	
Dolichopodidae	1		
Glyptotendipes		1	
Gonomyia			1
Harnischia			1
Hemerodromia	1		
Hydrobaenus	1		
Nanocladius	1	1	1
Nilotanypus		1	
Parametriochnemus			3
Paratanytarsus	17	28	4
Paratendipes	3		1
Pericoma		1	
Phaenopsectra	8		
Polypedilum convictum	1	1	7
Polypedilum halterale grp	8		

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0804079], Station #2, Sample Date: 9/24/2008 12:30:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Polypedilum illinoense grp	4	3	6
Polypedilum scalaenum grp	3	1	
Pseudosmittia			1
Rheotanytarsus	4	11	4
Saetheria	17	1	12
Scatophagidae	1		
Simulium	2		2
Stenochironomus		1	1
Tanytarsus	100	77	39
Thienemanniella	1	2	4
Thienemannimyia grp.	6	25	11
Tipula	1	1	
Tipulidae	1		
Zavrelimyia	4	9	3
<b>EPHEMEROPTERA</b>			
Acerpenna		26	2
Baetis			2
Caenis latipennis	6	4	
Callibaetis	1	2	
Centroptilum	1	1	
Leptophlebiidae	1	3	
Procloeon	2		4
Stenonema femoratum	1		1
<b>HEMIPTERA</b>			
Belostoma		-99	
Microvelia			1
Ranatra fusca		-99	
Sigara	2	1	
<b>LIMNOPHILA</b>			
Physella	14	18	5
<b>ODONATA</b>			
Calopteryx		-99	
Enallagma	1		
Somatochlora		2	
<b>RHYNCHOBDELLIDA</b>			
Glossiphoniidae	1		
<b>TRICHOPTERA</b>			
Cheumatopsyche		15	10
Ptilostomis		1	
<b>TRICLADIDA</b>			

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0804079], Station #2, Sample Date: 9/24/2008 12:30:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Planariidae		1	
TUBIFICIDA			
Enchytraeidae			6
Tubificidae	8	20	3

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0804077], Station #1, Sample Date: 9/23/2008 2:45:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>COLEOPTERA</b>			
Agabus	2		
Berosus	5		1
Coleoptera	2		
Enochrus	1		
Helichus basalis	5	11	10
Laccophilus	1		
Neoporus	1		
Paracymus	2		
Scirtidae	9	1	
<b>DIPTERA</b>			
Ablabesmyia		1	
Anopheles	1		
Ceratopogoninae	1		
Chironomidae	8	2	1
Chironomus	1		
Chrysops	2		
Cricotopus bicinctus	3	1	
Cricotopus/Orthocladius	79	26	33
Dicrotendipes	2		1
Diptera	21	2	8
Dolichopodidae		1	2
Ephydriidae	3		
Glyptotendipes			1
Gonomyia	2		
Harnischia	2		
Hydrobaenus	15	3	5
Limnophyes	1	1	1
Mesosmittia	1		1
Nanocladius	1		1
Ormosia	2		
Parametriocnemus			1
Paraphaenocladius	2	1	
Paratanytarsus	4	1	
Paratendipes	1		
Pericoma	6	1	
Polypedilum convictum	3		1
Polypedilum halterale grp	4		
Polypedilum illinoense grp	3		7
Procladius	1		

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0804077], Station #1, Sample Date: 9/23/2008 2:45:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Pseudosmittia	2	1	5
Psychoda	1		
Rheotanytarsus	1	1	
Saetheria	28	13	2
Sciomyzidae		1	
Simulium	8	2	
Stenochironomus			1
Stratiomyidae		1	
Stratiomys	1		
Tanytarsus	7	3	4
Thienemanniella	2	1	3
Thienemannimyia grp.		3	
Tipula	1	1	
Tribelos		1	
Zavrelimyia	1	2	
<b>EPHEMEROPTERA</b>			
Caenis latipennis	6	2	
Callibaetis	1		
<b>HEMIPTERA</b>			
Microvelia		1	
<b>LEPIDOPTERA</b>			
Crambidae	1		
<b>LIMNOPHILA</b>			
Fossaria		2	
Physella	10	11	
<b>ODONATA</b>			
Ischnura	3		
Libellula	1		
Pantala		1	
Plathemis	2	-99	
<b>TRICHOPTERA</b>			
Cheumatopsyche			1
Ptilostomis	1		
<b>TUBIFICIDA</b>			
Enchytraeidae	8	2	5
Tubificidae	13	6	6

# **Aquid Invertebrate Database Bench Sheet Report**

**Owl Br [0804080], Station #1, Sample Date: 9/24/2008 3:30:00 PM**

**NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>AMPHIPODA</b>			
Hyaella azteca		8	
<b>COLEOPTERA</b>			
Dubiraphia		1	
Dytiscidae	1		
Helichus basalis	3	40	1
Scirtidae			1
Tropisternus		1	
<b>DIPTERA</b>			
Aedes	2		
Ceratopogoninae		3	
Chironomidae	2	9	1
Chironomus		1	1
Chrysops	1		
Cladotanytarsus	4		2
Corynoneura		1	
Cricotopus bicinctus		5	
Cricotopus/Orthocladius	6	15	
Cryptochironomus		1	
Diplocladius		1	
Diptera	1	5	
Dolichopodidae		2	
Ephydriidae	1		
Gonomyia	1	4	
Hydrobaenus		4	1
Limnophyes		6	
Micropsectra		4	
Nanocladius		3	
Parametriocnemus	3	1	
Paraphaenocladius	1	3	1
Paratanytarsus		3	
Paratendipes		1	
Pericoma		3	
Phaenopsectra		1	
Pilaria		1	
Polypedilum convictum		1	
Polypedilum fallax grp		1	
Polypedilum halterale grp		2	
Polypedilum illinoense grp	2	8	4
Polypedilum scalaenum grp		2	

**Aquid Invertebrate Database Bench Sheet Report****Owl Br [0804080], Station #1, Sample Date: 9/24/2008 3:30:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Pseudorthocladius		1	
Pseudosmittia		1	
Psychoda		2	
Rheotanytarsus		1	
Saetheria	2	2	1
Simulium	1	8	
Tabanus			1
Tanytarsus		3	1
Thienemanniella		2	
Thienemannimyia grp.	1	35	1
Tipula	1	7	
Tipulidae	1		
Zavrelimyia	8	53	
<b>EPHEMEROPTERA</b>			
Caenis latipennis	5	7	
Callibaetis		1	
Leptophlebiidae		1	
Pseudocloeon		1	
<b>HEMIPTERA</b>			
Belostoma		3	
Microvelia	1		
<b>LIMNOPHILA</b>			
Physella	2	5	1
<b>LUMBRICINA</b>			
Lumbricina		1	
<b>ODONATA</b>			
Calopteryx		4	
Enallagma		1	
Gomphidae		1	
<b>TRICHOPTERA</b>			
Cheumatopsyche		5	
Limnephilidae	1		
<b>TUBIFICIDA</b>			
Enchytraeidae	4	26	2
Tubificidae	1	14	



**Aquid Invertebrate Database Bench Sheet Report****Trib. No Cr [0804081], Station #1, Sample Date: 9/24/2008 6:00:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	1		
<b>AMPHIPODA</b>			
Crangonyx		6	
Hyalella azteca	61	170	139
<b>BRANCHIOBDELLIDA</b>			
Branchiobdellida		1	
<b>COLEOPTERA</b>			
Dytiscidae	8	10	1
Helichus basalis		2	2
Neoporus		1	
Scirtidae	1	7	3
Tropisternus	-99		
<b>DECAPODA</b>			
Orconectes immunis		-99	
<b>DIPTERA</b>			
Ablabesmyia		1	1
Anopheles	1	2	1
Ceratopogoninae	4		
Chironomidae	1		
Chironomus	3		
Chrysops	8	2	
Cladotanytarsus	3	1	
Corynoneura		1	
Cricotopus bicinctus	2	1	1
Cricotopus/Orthocladius	7	6	5
Cryptochironomus	3		
Dicrotendipes	2		1
Diptera	9		2
Dolichopodidae	1		
Endochironomus			1
Ephydriidae		1	
Forcipomyiinae			2
Glyptotendipes	4	5	1
Gonomyia	1		
Hydrobaenus	3		
Limnophyes			1
Mesosmittia			1
Ormosia		1	
Parachironomus	1		1

**Aquid Invertebrate Database Bench Sheet Report****Trib. No Cr [0804081], Station #1, Sample Date: 9/24/2008 6:00:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Parametrioctenus		1	1
Paratanytarsus	17	3	1
Phaenopsectra		3	2
Polypedilum halterale grp	11		
Polypedilum illinoense grp	6	4	7
Sciomyzidae			1
Simulium	2	5	2
Tanytarsus	3	2	2
Thienemanniella	2	7	1
Thienemannimyia grp.	6	13	3
Tipulidae	2		
Zavrelimyia	3	11	5
<b>EPHEMEROPTERA</b>			
Caenis punctata	51	16	1
Callibaetis		4	1
<b>HEMIPTERA</b>			
Belostoma	-99	-99	
Corixidae	1		
Neoplea	1	1	
Trichocorixa		2	
<b>LIMNOPHILA</b>			
Lymnaeidae		4	3
Physella	15	47	3
<b>ODONATA</b>			
Argia		2	
Enallagma	11	9	2
Ischnura		4	
<b>TRICLADIDA</b>			
Planariidae	2	6	3
<b>TUBIFICIDA</b>			
Aulodrilus	6		
Enchytraeidae	5	7	
Tubificidae	47	7	
<b>VENEROIDA</b>			
Pisidiidae	8		

**Aquid Invertebrate Database Bench Sheet Report****Big Muddy Cr [0804082], Station #1, Sample Date: 9/25/2008 9:00:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>AMPHIPODA</b>			
Hyaella azteca		2	
<b>COLEOPTERA</b>			
Berosus		3	
Gymnochthebius		1	
Helichus basalis	1	1	1
Neoporus	1		
Scirtidae		8	
Stenelmis			1
<b>DIPTERA</b>			
Ablabesmyia	3	9	1
Ceratopogoninae	3	1	
Chironomus	24	10	1
Corynoneura	1	1	1
Cricotopus bicinctus	4	12	13
Cricotopus/Orthocladius	4	22	17
Cryptochironomus	6		
Culicidae	1		
Dicrotendipes	1	1	49
Glyptotendipes	1		7
Hydrobaenus	3	1	
Labrundinia		3	
Muscidae	1		
Nanocladius		2	4
Ormosia		2	
Paracladopelma	1		1
Paratanytarsus	11	22	11
Phaenopsectra	5	1	1
Polypedilum		1	6
Polypedilum convictum	5	10	15
Polypedilum fallax grp		1	3
Polypedilum halterale grp	76	1	1
Polypedilum illinoense grp	5	21	13
Pseudosmittia		1	3
Psychoda	1		
Rheocricotopus	2	7	9
Rheotanytarsus	5	9	9
Saetheria	4		2
Simulium		8	8
Stenochironomus			19

**Aquid Invertebrate Database Bench Sheet Report****Big Muddy Cr [0804082], Station #1, Sample Date: 9/25/2008 9:00:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Tabanus	2	-99	
Tanytarsus	43	49	61
Thienemanniella	3	8	8
Thienemannimyia grp.	1	10	14
Tipula		4	
Tipulidae	4		
Zavrelimyia	1	3	
<b>EPHEMEROPTERA</b>			
Baetis		2	31
Caenis latipennis	1	11	
Caenis punctata	10	8	
Callibaetis	1		
Leptophlebiidae	2		
Stenacron			1
<b>HEMIPTERA</b>			
Neoplea		1	
<b>LIMNOPHILA</b>			
Lymnaeidae			1
Physella	9	5	1
<b>LUMBRICINA</b>			
Lumbricina	1		-99
<b>ODONATA</b>			
Argia		5	1
Calopteryx	1		
Enallagma		2	
Ischnura	1	2	
Macromia		2	
Progomphus obscurus	6	-99	
<b>TRICHOPTERA</b>			
Cheumatopsyche	1	23	24
Hydroptilidae			1
<b>TUBIFICIDA</b>			
Enchytraeidae	4	9	2
Limnodrilus hoffmeisteri	1		
Tubificidae	47	21	3
<b>VENEROIDA</b>			
Pisidiidae	1	1	

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0930031], Station #1, Sample Date: 4/7/2009 12:45:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
AMPHIPODA			
Crangonyx	13	21	1
COLEOPTERA			
Berosus	1		
Helichus basalis		1	
Scirtidae			1
DECAPODA			
Orconectes immunis		1	
DIPTERA			
Ablabesmyia	3		
Aedes	3		
Ceratopogoninae	25	6	1
Chironomidae	3	2	1
Chironomus	1		
Chrysops	6		
Corynoneura	2		2
Cricotopus bicinctus	1	2	
Cricotopus/Orthocladius	3	48	13
Cryptochironomus	9	2	
Dicrotendipes			1
Diptera	15	3	
Dolichopodidae		1	1
Eukiefferiella		6	
Hydrobaenus	12	7	5
Limonia			1
Mesosmittia			1
Natarsia		3	
Ormosia	25	6	2
Parametriocnemus		4	1
Paraphaenocladius	2	3	1
Paratanytarsus	2	8	1
Paratendipes	1		
Pericoma	1	1	
Phaenopsectra		5	3
Pilaria	-99		
Polypedilum convictum	1	6	
Polypedilum fallax grp			1
Polypedilum halterale grp	29		
Polypedilum illinoense grp	1	11	4
Polypedilum scalaenum grp	2	1	

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0930031], Station #1, Sample Date: 4/7/2009 12:45:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Pseudosmittia			1
Rheotanytarsus		7	
Saetheria	37	3	3
Simulium		5	
Smittia	3	1	
Tabanus	-99		
Tanytarsus		3	2
Thienemanniella	1	2	
Thienemannimyia grp.	8	35	4
Tipula	1	2	
Zavrelimyia	13	7	1
<b>EPHEMEROPTERA</b>			
Caenis latipennis	8	9	
Caenis punctata	1		
Centroptilum	1		
<b>HEMIPTERA</b>			
Belostoma		-99	
Sigara	3		
<b>LIMNOPHILA</b>			
Lymnaeidae	2		
Physella	1		
<b>PLECOPTERA</b>			
Perlesta		18	1
<b>TRICHOPTERA</b>			
Cheumatopsyche	-99	2	5
Ironoquia		10	
<b>TUBIFICIDA</b>			
Enchytraeidae	43	49	2
Ilyodrilus templetoni	1		
Limnodrilus cervix	2		
Limnodrilus hoffmeisteri			1
Tasserkidrilus superiorenensis	1	1	
Tubificidae	36	10	1

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0930032], Station #2, Sample Date: 4/7/2009 2:15:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	2		
<b>AMPHIPODA</b>			
Crangonyx	11	29	
<b>COLEOPTERA</b>			
Dytiscidae	-99		
<b>DECAPODA</b>			
Orconectes immunis		-99	
<b>DIPTERA</b>			
Ceratopogoninae	4	3	
Chironomidae	4	2	
Cladotanytarsus	1		
Corynoneura	2		
Cricotopus bicinctus	2	5	4
Cricotopus/Orthocladius	31	74	58
Cryptochironomus	6		
Diplocladius		1	
Diptera	4	2	1
Eukiefferiella	1	2	6
Eukiefferiella brevicar grp			1
Hemerodromia	1	1	
Hydrobaenus	18	10	3
Limnophyes	1	1	
Ormosia	5	2	
Parametriocnemus	1	12	
Paratanytarsus	17	5	
Pericoma	1		
Pilaria	1	1	
Polypedilum convictum	1	3	
Polypedilum fallax grp			1
Polypedilum halterale grp	4	1	
Polypedilum illinoense grp	6	7	
Polypedilum scalaenum grp	2	1	
Rheocricotopus		1	
Rheotanytarsus	3	3	2
Saetheria	96	18	2
Simulium		3	
Stegopterna	1	2	
Stenochironomus	1		
Tanytarsus	4	6	

**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0930032], Station #2, Sample Date: 4/7/2009 2:15:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Thienemanniella	1	2	
Thienemannimyia grp.	18	30	1
Zavreliomyia	5	2	
<b>EPHEMEROPTERA</b>			
Acerpenna	3	5	
Caenis latipennis	6	12	
Stenonema femoratum			1
<b>HEMIPTERA</b>			
Belostoma	-99	-99	
<b>PLECOPTERA</b>			
Amphinemura		7	1
Perlesta		5	
<b>TRICHOPTERA</b>			
Cheumatopsyche	1	2	
Ironoquia	4	12	
Ptilostomis	-99		
<b>TRICLADIDA</b>			
Planariidae		1	
<b>TUBIFICIDA</b>			
Enchytraeidae	18	5	
Ilyodrilus templetoni	2		
Limnodrilus hoffmeisteri	2		
Tasserkidrilus superiorensis	1		
Tubificidae	35	6	



**Aquid Invertebrate Database Bench Sheet Report****Trib. Hickory Cr [0930035], Station #1, Sample Date: 4/8/2009 10:00:00 AM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>AMPHIPODA</b>			
Crangonyx	-99	3	
<b>COLEOPTERA</b>			
Agabus		1	
Helichus basalis		1	
Scirtidae		1	
<b>DIPTERA</b>			
Ablabesmyia		1	
Chironomidae		3	
Cricotopus bicinctus		4	1
Cricotopus/Orthocladius	5	44	12
Cryptochironomus	1	1	
Cryptotendipes	23	7	2
Diamesa		1	
Dicrotendipes		2	
Diplocladius	1	5	
Diptera	2		
Dolichopodidae	1	2	
Glyptotendipes		1	
Hydrobaenus	55	149	29
Labrundinia	1	1	
Paraphaenocladius	2	1	
Paratanytarsus	2	6	
Phaenopsectra		1	
Polypedilum aviceps		2	1
Polypedilum convictum		1	
Polypedilum halterale grp	5		
Polypedilum illinoense grp	7	25	3
Pseudolimnophila		1	
Simulium	1	3	1
Tanytarsus		5	
Thienemannimyia grp.	1	3	1
Tipula		-99	
<b>TRICHOPTERA</b>			
Ironoquia	2	4	
<b>TRICLADIDA</b>			
Planariidae			1
<b>TUBIFICIDA</b>			
Enchytraeidae	3	8	1

**Aquid Invertebrate Database Bench Sheet Report****Owl Br [0930034], Station #1, Sample Date: 4/7/2009 6:00:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>AMPHIPODA</b>			
Hyaella azteca		1	
<b>COLEOPTERA</b>			
Agabus		1	
Helichus basalis	1	2	1
Laccophilus		1	
Paracymus	1		
Peltodytes		2	
Tropisternus	-99		
<b>DECAPODA</b>			
Orconectes virilis		1	
<b>DIPTERA</b>			
Ceratopogoninae		1	
Chironomidae	2	4	
Corynoneura	4	9	
Cricotopus bicinctus	1	2	
Cricotopus/Orthocladius	16	98	5
Diplocladius	1	4	1
Eukiefferiella		1	1
Hydrobaenus	32	56	2
Limnophyes	1	5	
Mesosmittia	1		
Ormosia	3		
Parametriocnemus	2	11	
Paraphaenocladius	1	3	
Paratanytarsus	1		
Phaenopsectra	2		
Polypedilum halterale grp	2		
Polypedilum illinoense grp	7	14	
Pseudolimnophila		1	1
Saetheria	55	6	
Simulium	1		
Stegopterna		1	
Tanytarsus		7	
Thienemanniella		3	
Thienemannimyia grp.		9	
Tipula	-99	-99	
Tipulidae		1	
Zavreliomyia	2	7	
<b>EPHEMEROPTERA</b>			

**Aquid Invertebrate Database Bench Sheet Report****Owl Br [0930034], Station #1, Sample Date: 4/7/2009 6:00:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Leptophlebiidae		3	
HEMIPTERA			
Microvelia		1	
LIMNOPHILA			
Lymnaeidae	1	1	
PLECOPTERA			
Amphinemura		1	
Perlesta	1		
TRICHOPTERA			
Ironoquia	4	17	4
TRICLADIDA			
Planariidae	1	1	
TUBIFICIDA			
Enchytraeidae	17	14	2
Limnodrilus hoffmeisteri	2		
Tubificidae	7		

**Aquid Invertebrate Database Bench Sheet Report****Trib No Cr [0930033], Station #1, Sample Date: 4/7/2009 4:15:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	1	1	1
<b>AMPHIPODA</b>			
Crangonyx	6	27	2
Hyaella azteca		-99	
<b>COLEOPTERA</b>			
Agabus		2	
Helichus basalis		2	
Laccophilus		1	
Neoporus		1	
<b>DECAPODA</b>			
Orconectes virilis		-99	
<b>DIPTERA</b>			
Ceratopogoninae	2	12	
Chironomidae		1	3
Chrysops	2	1	
Corynoneura	1	8	1
Cricotopus/Orthocladius	24	45	93
Dicrotendipes			2
Diplocladius	1	2	
Diptera		1	
Eukiefferiella			4
Glyptotendipes			1
Hydrobaenus	193	88	67
Ormosia	1		
Parametriocnemus		4	2
Paraphaenocladius		1	
Paratanytarsus	1	3	
Paratendipes		1	
Phaenopsectra		1	14
Polypedilum aviceps		2	
Polypedilum fallax grp			4
Polypedilum illinoense grp		4	12
Polypedilum scalaenum grp	1		
Saetheria	4		
Simulium		1	
Stegopterna			4
Tanytarsus	2	1	
Thienemanniella		1	
Thienemannimyia grp.	3	7	1

**Aquid Invertebrate Database Bench Sheet Report****Trib No Cr [0930033], Station #1, Sample Date: 4/7/2009 4:15:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Tipulidae	1		
Zavrelimyia	1	15	5
<b>EPHEMEROPTERA</b>			
Baetidae	2		
Caenis latipennis	5	19	3
Leptophlebiidae		6	
<b>HEMIPTERA</b>			
Belostoma		-99	
Microvelia		1	
Neoplea	1		
<b>LIMNOPHILA</b>			
Lymnaeidae	1	1	
Menetus		1	
Physella		3	
<b>ODONATA</b>			
Argia		1	
Enallagma		1	
Somatochlora		-99	
<b>TRICHOPTERA</b>			
Cheumatopsyche			1
Isonychia		9	6
<b>TUBIFICIDA</b>			
Enchytraeidae	1	8	3
Limnodrilus claparedianus	6	2	2
Limnodrilus hoffmeisteri	4	6	
Tubificidae	18	7	3

**Aquid Invertebrate Database Bench Sheet Report****Big Muddy Cr [0930036], Station #1, Sample Date: 4/8/2009 12:45:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
<b>"HYDRACARINA"</b>			
Acarina	2		
<b>AMPHIPODA</b>			
Hyaella azteca	1		
<b>ARHYNCHOBDELLIDA</b>			
Erpobdellidae	-99		
<b>COLEOPTERA</b>			
Agabus		-99	
Gyrinus	-99		
<b>DIPTERA</b>			
Ablabesmyia	3	2	1
Ceratopogoninae	7		
Chironomidae	2	2	1
Corynoneura		1	
Cricotopus bicinctus	1	13	13
Cricotopus/Orthocladius	24	59	104
Cryptochironomus	6		1
Dicrotendipes	15	1	8
Diptera			1
Endochironomus	1		
Eukiefferiella			5
Glyptotendipes	1	1	1
Hemerodromia			1
Hydrobaenus	50	84	116
Nanocladius	3		
Nilothauma	1		
Paralauterborniella	1		
Paratanytarsus	32	22	8
Paratendipes	1		
Phaenopsectra	2	1	
Polypedilum convictum	1	17	8
Polypedilum fallax grp	1		
Polypedilum halterale grp	48		
Polypedilum illinoense grp	4	4	7
Polypedilum scalaenum grp	8		
Pseudochironomus	1		
Rheotanytarsus	8	14	2
Saetheria	6	4	3
Simulium	4	10	8
Stictochironomus	3		

**Aquid Invertebrate Database Bench Sheet Report****Big Muddy Cr [0930036], Station #1, Sample Date: 4/8/2009 12:45:00 PM****NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence**

<b>ORDER: TAXA</b>	<b>NF</b>	<b>RM</b>	<b>SG</b>
Tanytarsus	35	23	10
Thienemanniella	1	2	
Thienemannimyia grp.	9	18	1
Zavrelimyia	1		
<b>EPHEMEROPTERA</b>			
Acerpenna		9	5
Caenis latipennis	6	6	1
Caenis punctata		1	
Heptagenia		4	
Stenacron	-99		
Stenonema femoratum		2	
<b>HEMIPTERA</b>			
Belostoma		-99	
<b>LUMBRICINA</b>			
Lumbricina	1		
<b>ODONATA</b>			
Argia	1		
Enallagma	-99	1	
<b>TRICHOPTERA</b>			
Cheumatopsyche	1	1	-99
Limnephilidae		1	
<b>TRICLADIDA</b>			
Planariidae	1		
<b>TUBIFICIDA</b>			
Aulodrilus	2		
Enchytraeidae	9	4	1
Limnodrilus cervix		1	
Limnodrilus hoffmeisteri	2		
Tubificidae	24		2